BE 102- Design and Engineering

Module 2

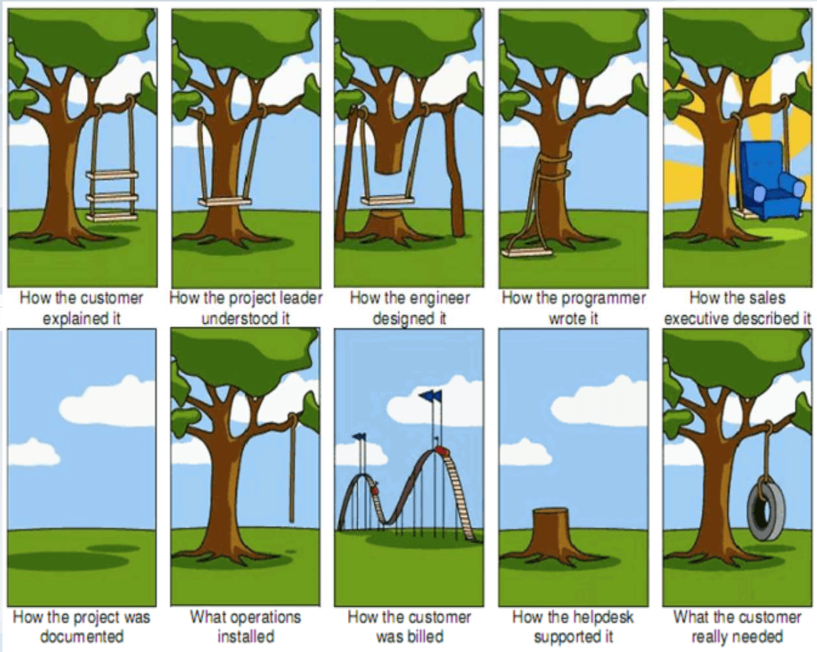

communication
design
media
methods
project
presentation
new
professional
shift
paradigm
different
creative
architectural
presenting
consultant
solutions
community
assets
architect
industry
notion
entire
one
ideas
now
presentations
specialist
delivery
talking
rather
generation
question
directly
audience
develops
complex
power
also
related
years
think
passed
type
seen
ask

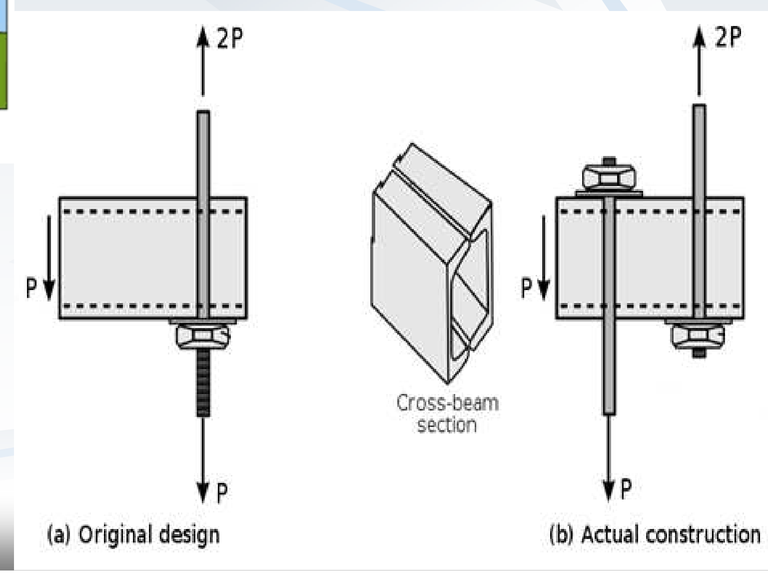
Design Communication

Communication the imparting or exchanging of information by speaking, writing, or using some other medium

- Throughout the design process team members should communicate properly to avoid design entanglement and other issues
- The proper communication between client, designer, marketing specialist, production engineer etc. will help to improve any designs.
- Communication issues may leads to too many design failures and other post production problems
- Feedback communication plays a vital role in improving designs

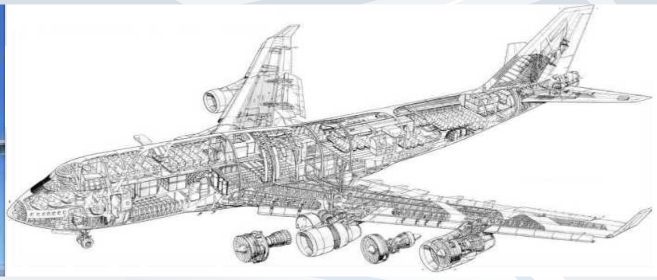
DESIGN COMMUNICATION





CONCEPT TO CONFIGURATION

- The strength of a designer lies in the ability to transform the design concept to a workable configuration.

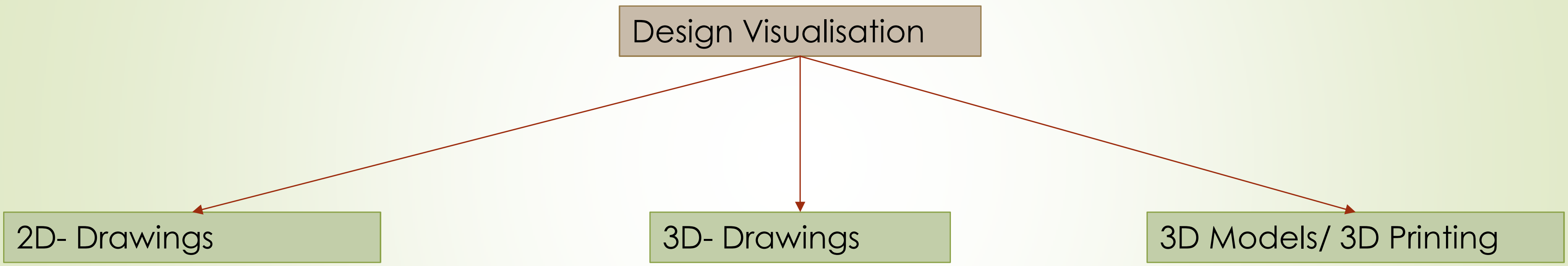



- The complexity of the product poses major challenges.
- Products are evolving because of design process.
- Complex designs needs sub system designs.
- Designs are configured out of such subsystem.

Example: Stapler, Bicycle

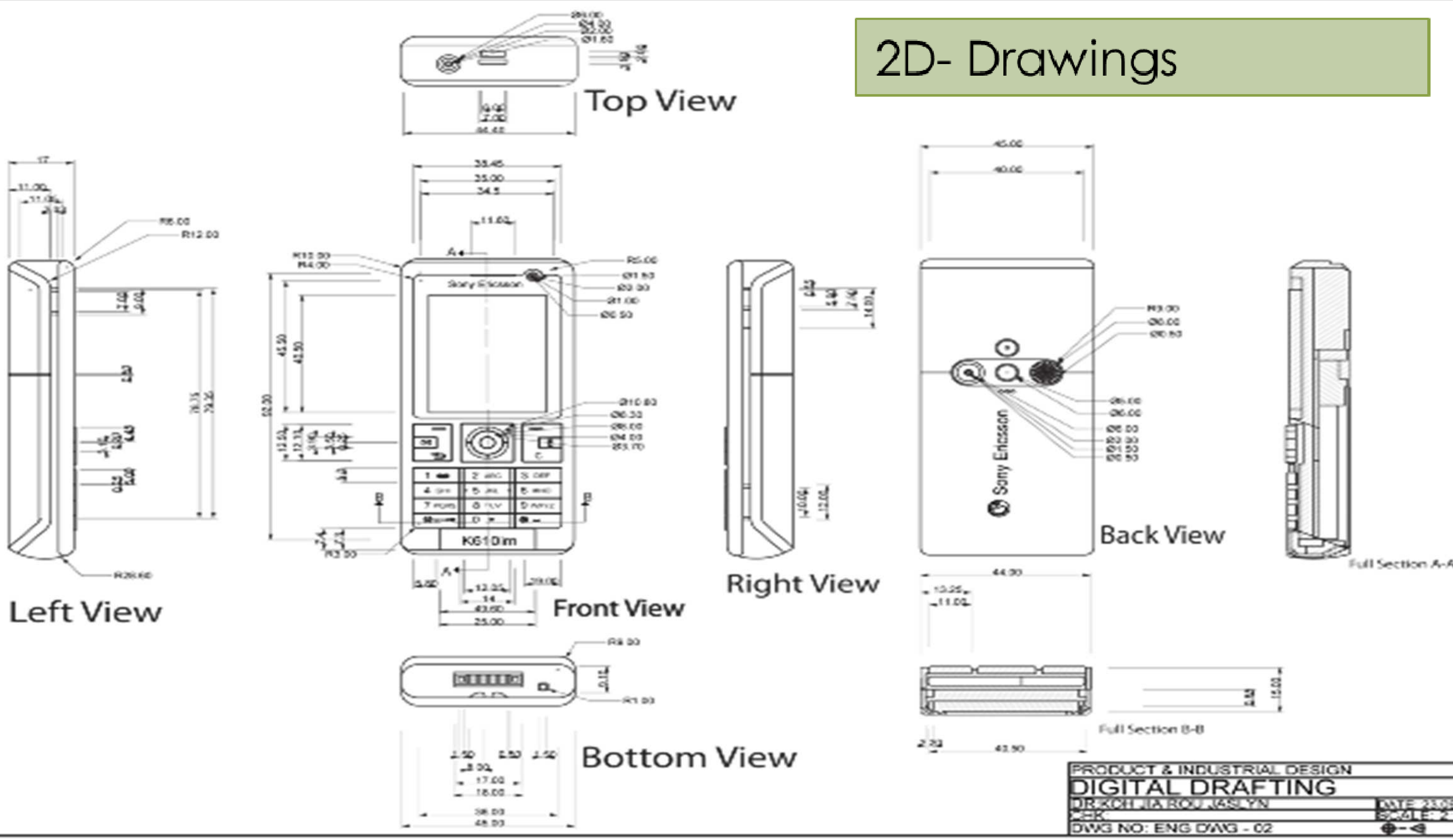
How to Communicate a Design

Communicate a Design is often more complex than any other information transferring process. Hence a designer might use different aspects of communication such as Visual, Verbal, Written etc.

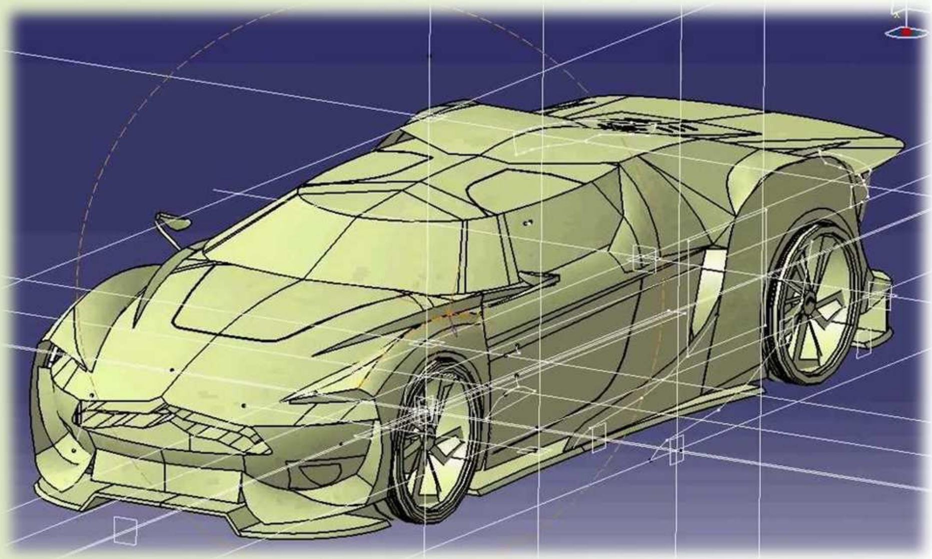


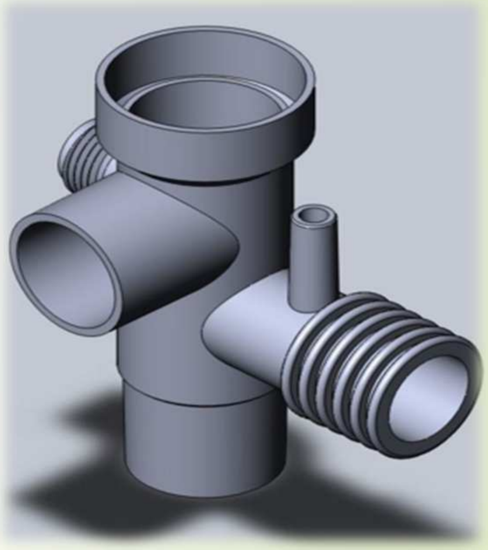
Documentation: One of the most important activities in design is documenting your work, clearly communicating the solution to your design problem so someone else can understand what you have created. Usually this consists of a design or technical report.

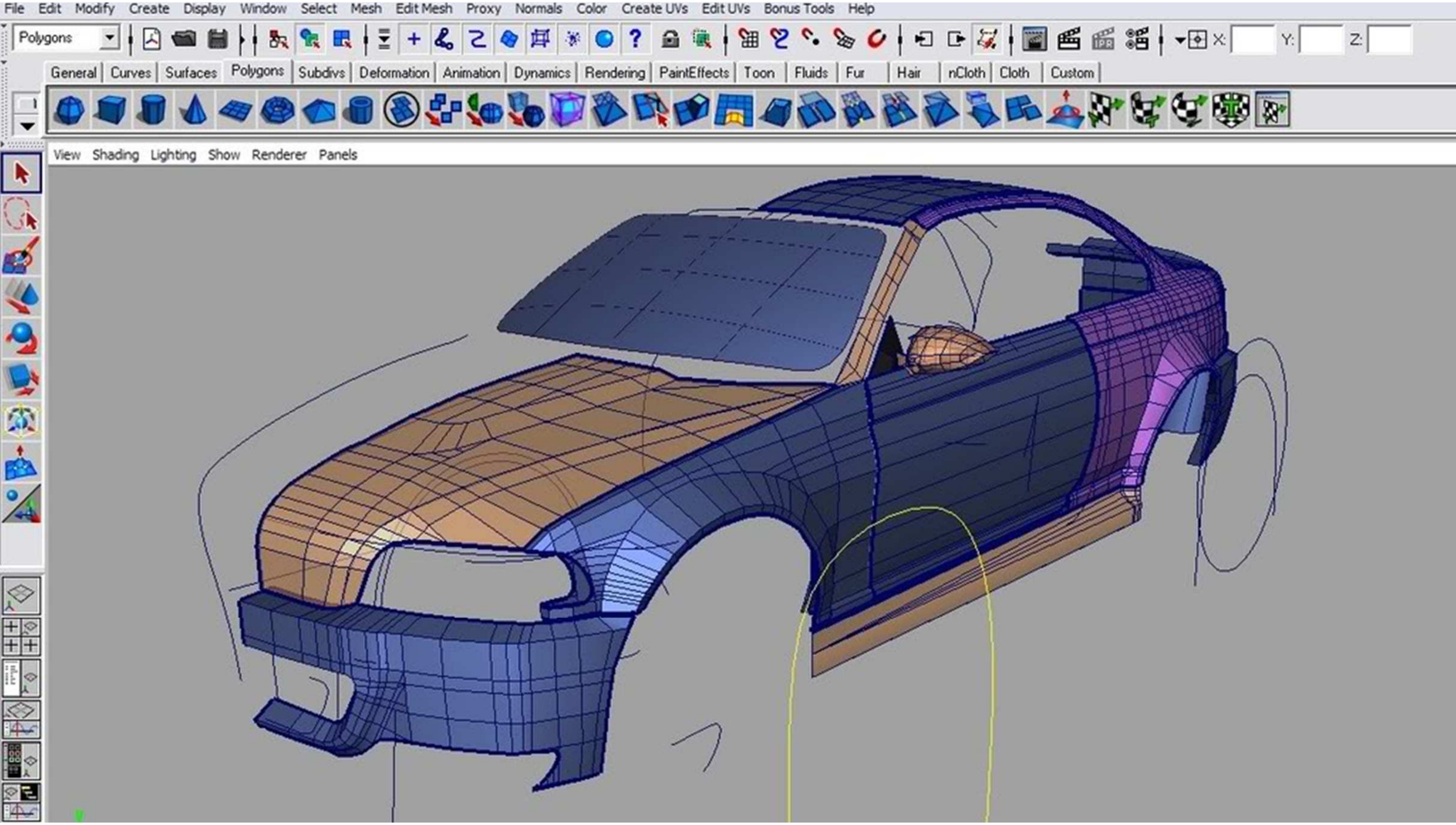
2D- Drawings

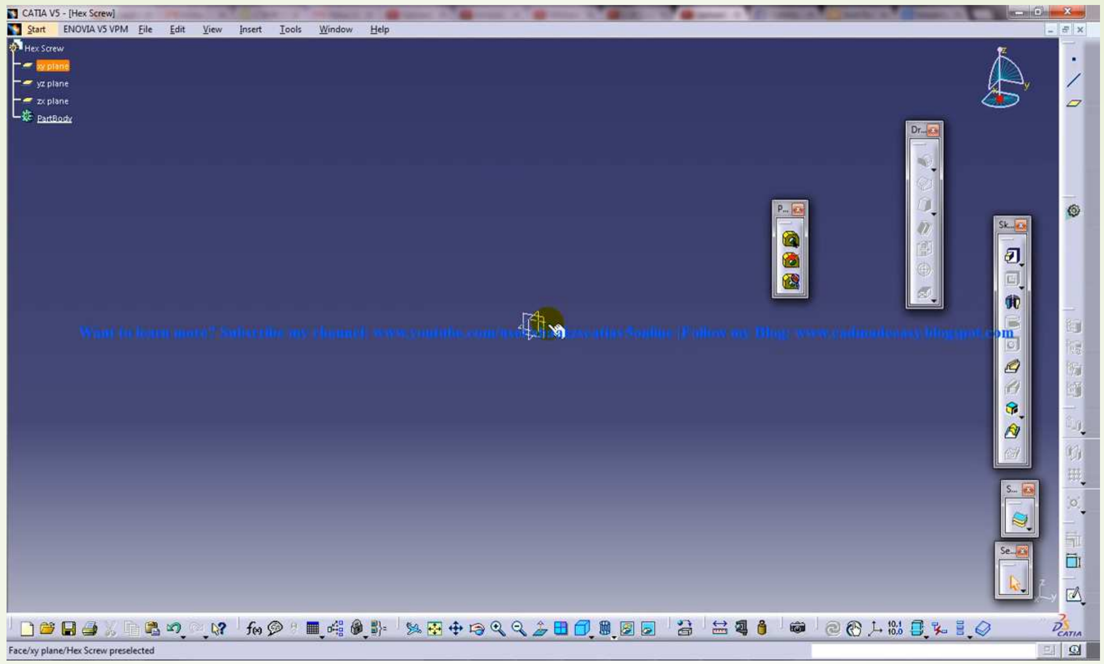

Top View
Left View
Front View
Right View
Back View
Bottom View
Full Section A-A
Full Section B-B
Sony Ericsson
K610im
PRODUCT & INDUSTRIAL DESIGN
DIGITAL DRAFTING
DR: KOH JIA ROU JASLYN
CHK:
DWG NO: ENG DWG - 02

3D- Drawings



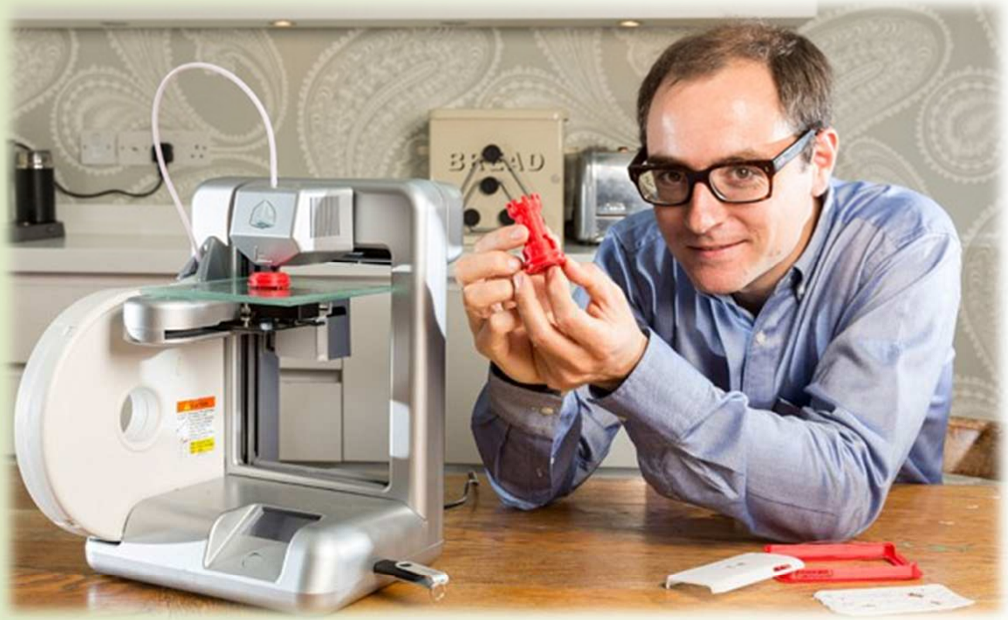


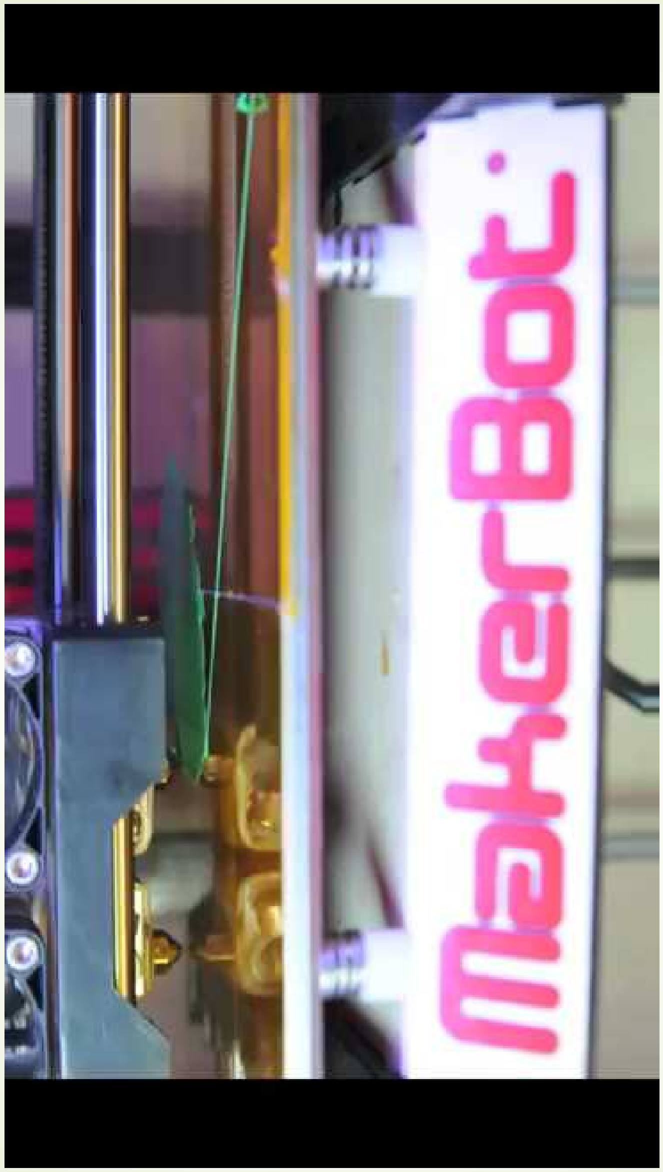

File Edit Modify Create Display Window Select Mesh Edit Mesh Proxy Normals Color Create UVs Edit UVs Bonus Tools Help
Polygons
X: Y: Z:
General Curves Surfaces Polygons Subdivs Deformation Animation Dynamics Rendering PaintEffects Toon Fluids Fur Hair nCloth Cloth Custom
View Shading Lighting Show Renderer Panels

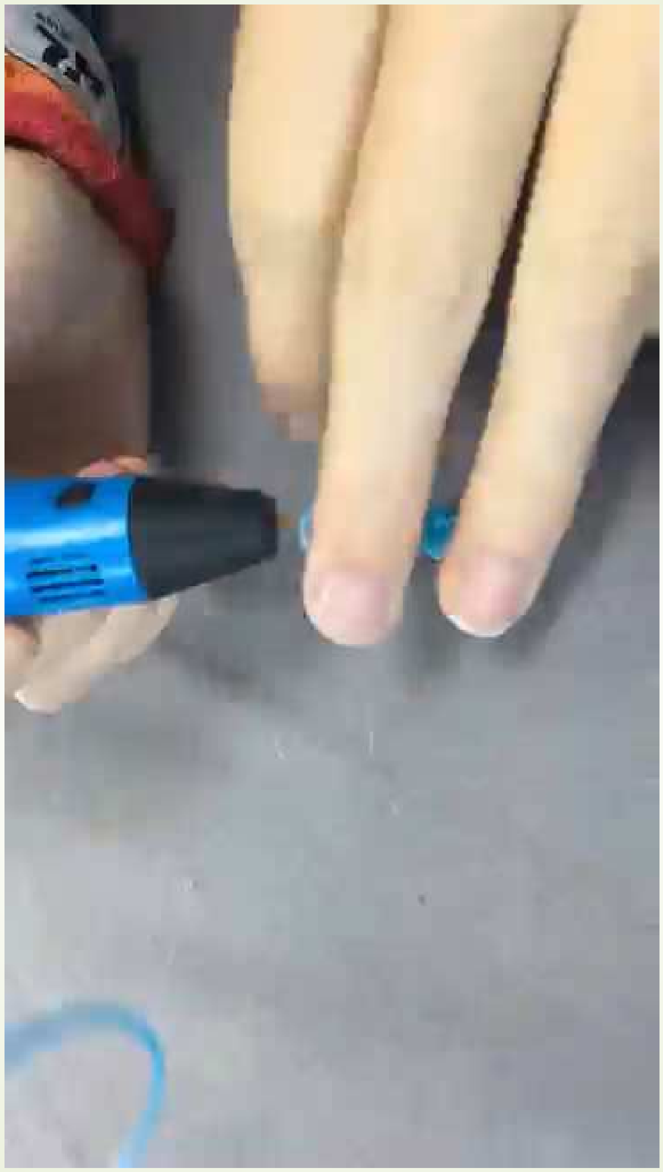

CATIA V5 - [Hex Screw]
Start
ENOVIA V5 VPM
File
Edit
View
Insert
Tools
Window
Help
Hex Screw
xy plane
yz plane
zx plane
PartBody
Face/xy plane/Hex Screw preselected

3D Models/ 3D Printing

It will bring hands-on experience to designers as well as client

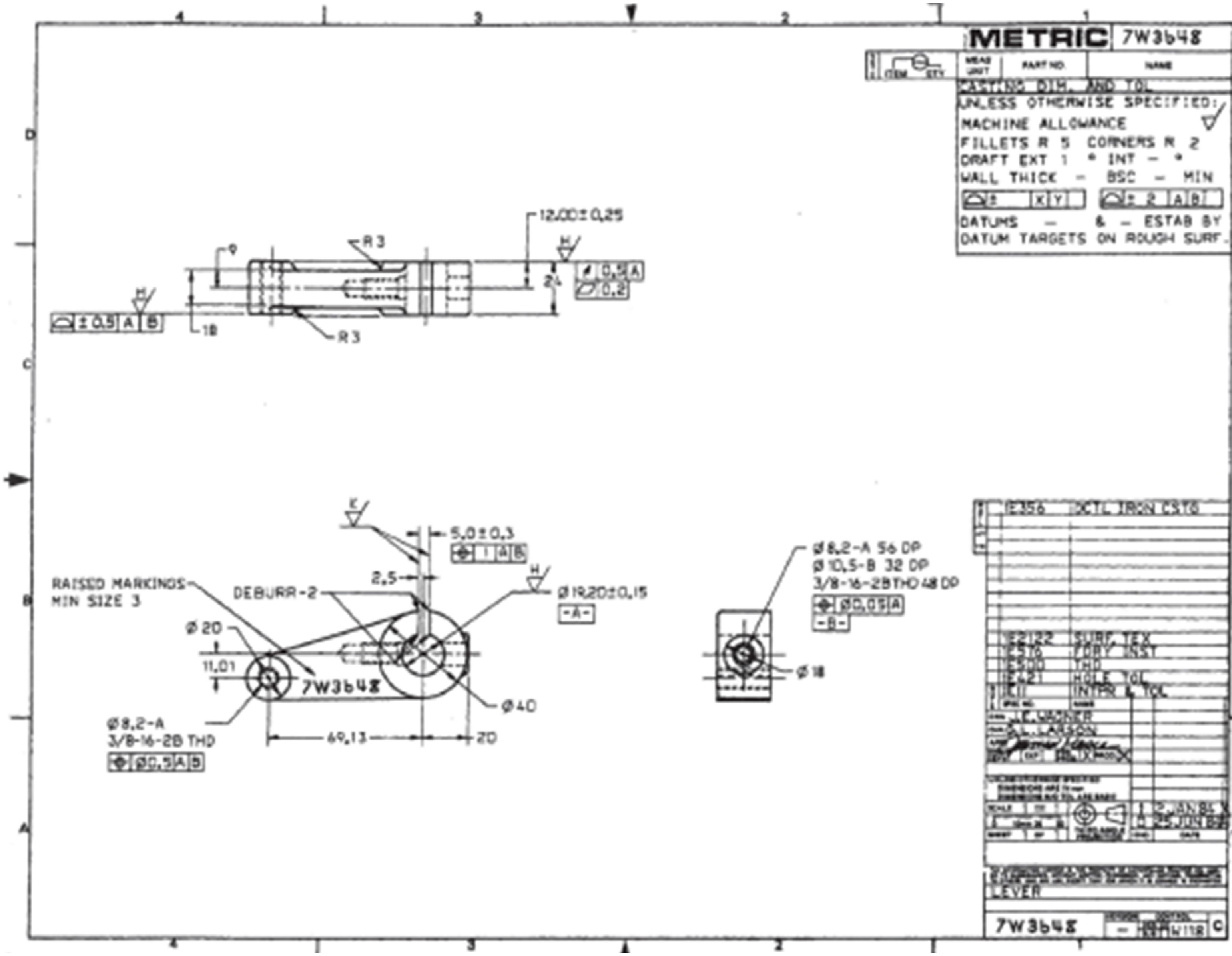



MakerBot

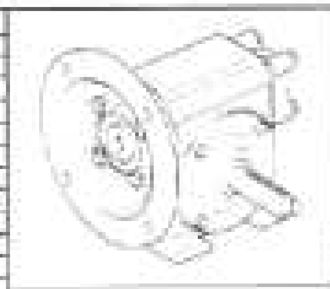


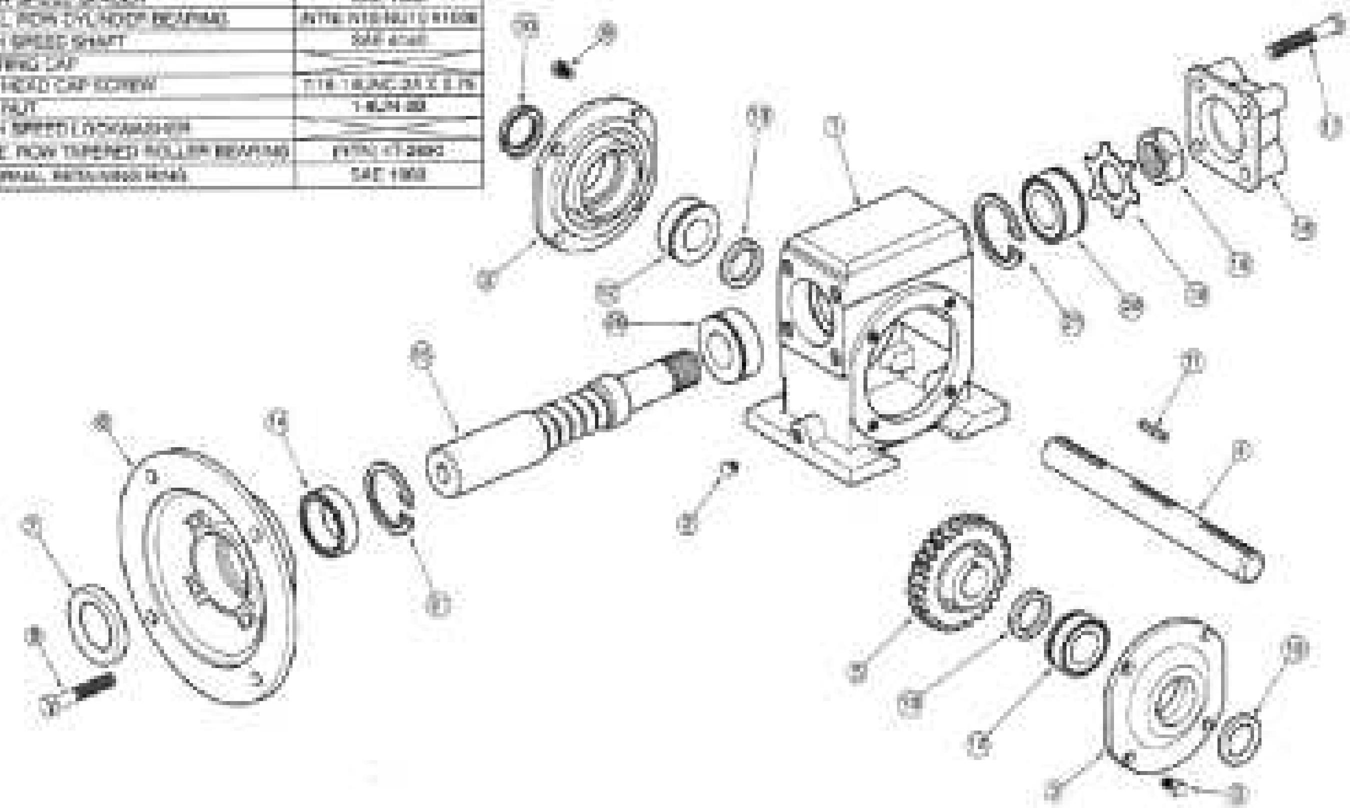
DETAIL DESIGNING

- **Make/buy decision:** *whether to make part or buy them*
- **Complete the selection and sizing of components:**
- **Complete engineering drawings:**
- **Complete the Bill of Materials:** *List of all parts, raw materials required to complete a single unit of product.*
- **Revise the product design specification:** *PDS detailed document that describes what the design must be in terms of performance requirements, product life, quality, reliability, cost, etc.*
- **Complete verification prototype testing:**
- **Prepare final cost estimate:** *Direct & indirect costs*
- **Prepare design project report:**
- **Final design project review:**
- **Release design to manufacturing:**


METRIC
7W3648
CASTING DIM. AND TOL
UNLESS OTHERWISE SPECIFIED:
MACHINE ALLOWANCE
FILLETS R 5 CORNERS R 2
DRAFT EXT 1 ° INT — °
WALL THICK — BSC — MIN
DATUMS — & — ESTAB BY
DATUM TARGETS ON ROUGH SURF.
12,00±0,25
R3
9
18
24
RAISED MARKINGS
MIN SIZE 3
DEBURR-2
5,0±0,3
2,5
Ø19,20±0,15
-A-
Ø20
11,01
Ø40
69,13
20
Ø8,2-A
3/8-16-2B THD
Ø8,2-A 56 DP
Ø10,5-B 32 DP
3/8-16-2BTHD 48 DP
-B-
Ø18
E356 DCTL IRON CSTG
SURF TEX
FORY INST
THD
HOLE TOL
INTRP & TOL
LEVER
7W3648

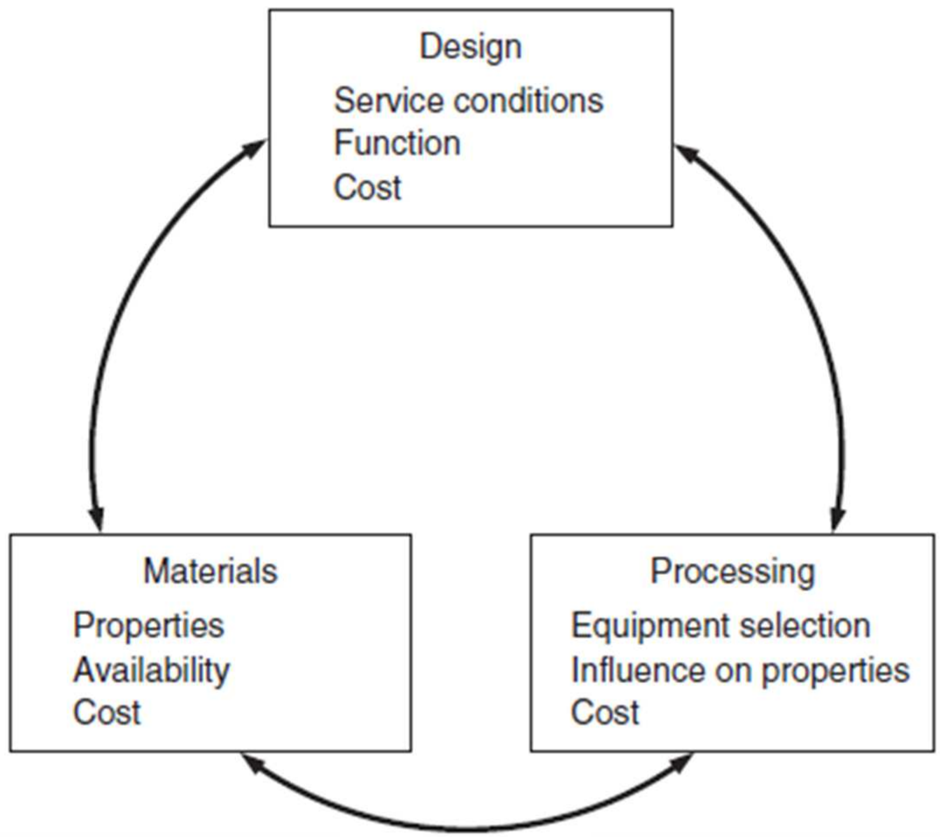
ITEM	QTY	NAME	DESCRIPTION
1	1	HOUSING	CAST IRON
2	2	TAPER PLUG	3/8-18NPT
3	3	RETAINING PLATE	CAST IRON
4	1	SLOW SPEED SHAFT	SAE 4140
5	1	WORM GEAR	BRONZE
6	1	MOTOR ADAPTOR	CAST IRON
7	1	HIGH SPEED OIL SEAL	
8	4	HEX HEAD CAP SCREW	7/16-14UNC-2A X 2.25
9	3	HEX HEAD CAP SCREW	1/2-13UNC-2A X .75
10	2	SLOW SPEED OIL SEAL	
11	1	SLOW SPEED KEYWAY	1/4 X 1/4 X 1.75
12	2	SNGL. ROW TAPER ROLLER BEARING	(NTN) 4T-LM67048
13	2	SLOW SPEED SPACER	SAE 1060
14	1	SNGL. ROW CYLINDER BEARING	(NTN) N10-NU10 N1008
15	1	HIGH SPEED SHAFT	SAE 4140
16	1	BEARING CAP	
17	4	HEX HEAD CAP SCREW	7/16-14UNC-2A X 2.75
18	1	HEX NUT	1-8UN 2B
19	2	HIGH SPEED LOCKWASHER	
20	2	DBLE. ROW TAPERED ROLLER BEARING	(NTN) 4T-2690
21	2	INTERNAL RETAINING RING	SAE 1060



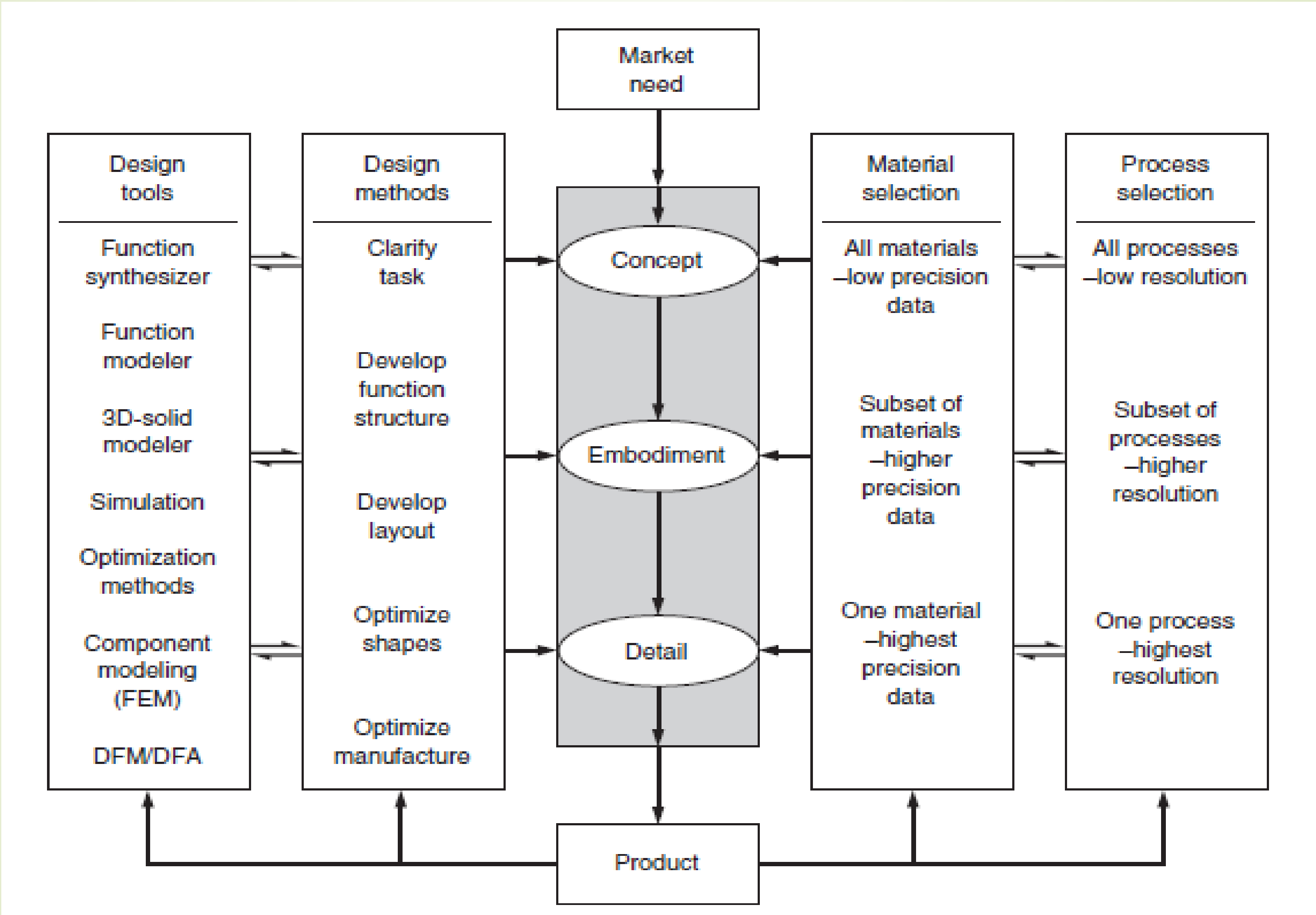


Material Selection

There are over 100,000 engineering materials to choose from. The typical design engineer should have ready access to information on 30 to 60 materials, depending on the range of applications he or she deals with.


Design
Service conditions
Function
Cost
Materials
Properties
Availability
Cost
Processing
Equipment selection
Influence on properties
Cost

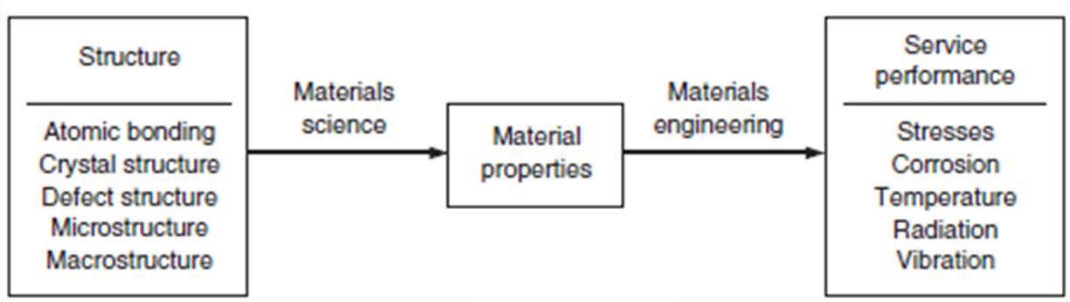
Material Selection Process



Material Selection Criteria

Materials are selected on the basis of four general criteria:

- Performance characteristics (properties)
- Processing (manufacturing) characteristics
- Environmental profile
- Business considerations



KINGDOM OF ENGINEERING MATERIALS

FAMILY
CLASS
SUBCLASS
MEMBER

METALS

- **Steels**
  - Plain carbon steel
    - AISI 1020
    - AISI 1040
  - Alloy steels
    - AISI 4140
    - AISI 4340
    - AISI 8620
  - Tool steels
    - O1 Oil hardening
    - H11 Hot work tool steel
    - M42 High-speed steel
  - Cast irons
    - Gray iron, class 20
    - Ductile cast iron
  - Stainless steel
    - AISI 304
    - AISI 316
    - AISI 440C
- **Aluminum Alloys**
  - 3003
  - 6061
  - 7075
  - 380
- **Copper Alloys**
  - ETP copper-C1100
  - Yellow brass-C36000
- **High-Performance Nonferrous Alloys**
  - Inconel 600 - Ni-Cr alloy
  - Stellite - Co-Cr-W alloy
  - Ti-6Al-4V

POLYMERS

- **Commodity Thermoplastics**
  - Polyethylene (PE)
  - Polystyrene (PS)
  - Polyvinyl chloride (PVC)
- **Engineering Thermoplastics**
  - Nylon 6/6
  - ABS
  - Polycarbonate (PC)
  - Polyurethane(PUR)
- **Thermosets-highly crosslinked**
  - Alkyds
  - Epoxies
  - Phenolics
  - Polyesters
- **Elastomers**
  - Rubbers
  - Silicone resins

CERAMICS

- **Carbides, Oxides, Nitrides**
  - Alumina, Al_2O_3
  - Silicon carbide, SiC
  - Silicon nitride, Si_3N_4
  - Toughened zirconia, ZrO_2
- **Cemented Carbides**
  - WC-6% Co
- **Carbon**
  - Carbon fibers
  - Graphite
- **Building Materials**
  - Bricks
  - Concrete
- **Glass**

COMPOSITES

- **Wood**
- **Fiber-Reinforced**
  - Carbon fiber-polymer matrix
  - Glass fiber-polymer matrix
- **Laminated composite**

A Short List of Material Properties

Structure-Insensitive Properties	Structure-Sensitive Properties
Melting point, T_m	Strength, σ_f, where f denotes a failure mode
Glass transition temperature, for polymers, T_g	Ductility
Density, ρ	Fracture toughness, K_{Ic}
Porosity	Fatigue properties
Modulus of elasticity, E	Damping capacity, η
Coefficient of linear thermal expansion, α	Creep
Thermal conductivity, k	Impact or shock loading resistance
Specific heat, c_p	Hardness
Corrosion rate	Wear rate or corrosion rate

Material Selection Criteria's

1.Availability

- Are there multiple sources of supply?
- What is the likelihood of availability in the future?
- Is the material available in the forms needed (tubes, wide sheet, etc.)?

2. Size limitations and tolerances on available material shapes and forms,

   e.g., sheet thickness or tube wall concentricity

3. Excessive variability in properties

4.Environmental impact, including ability to recycle the material

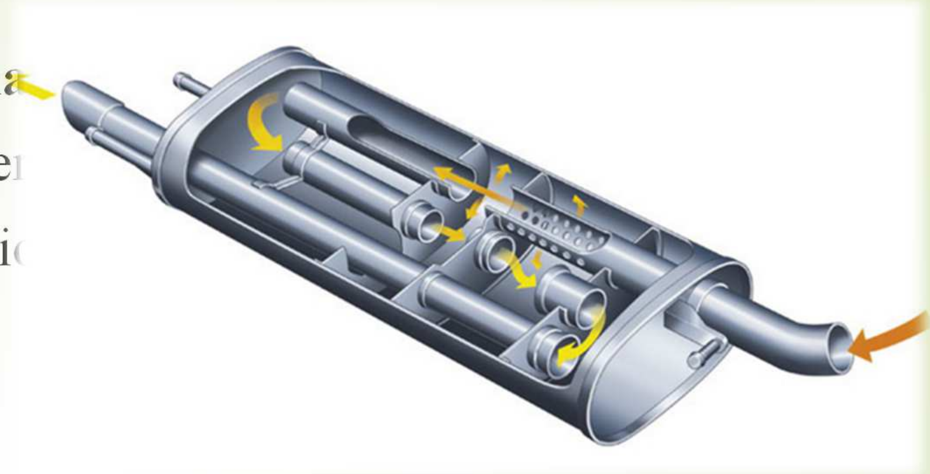
5. Cost. Materials selection comes down to buying properties at the best available price

Material Selection Example

Consider the question of materials selection for an **automotive exhaust system**. The product design specification states that it must provide the following functions:

- ✓ Conduct engine exhaust gases away from the engine
- ✓ Prevent noxious fumes from entering the car
- ✓ Cool the exhaust gases
- ✓ Reduce the engine noise
- ✓ Reduce the exposure of automobile body parts to exhaust gases
- ✓ Affect the engine performance as little as possible
- ✓ Help control unwanted exhaust emissions
- ✓ Have an acceptably long service life
- ✓ Have a reasonable cost, both as original equipment and as a replacement part

Material Requirements for an Automotive Exha



Mechanical property requirements not overly seve

- Suitable rigidity to prevent excessive vibrati
- Moderate fatigue resistance
- Good creep resistance in hot parts

Limiting property:

corrosion resistance , especially in the cold end where gases condense to form corrosive liquids.

Properties of unique interest:

The requirements are so special that only a few materials meet them regardless of cost.

- Pt-base catalysts in catalytic converter
- Special ceramic carrier that supports the catalyst

Previous materials used:

Low-carbon steel with corrosion-resistant coatings.

Material is relatively inexpensive, readily formed and welded. Life of tailpipe and muffler is limited.

Newer materials used:

With greater emphasis on automotive quality, many producers have moved to specially developed stainless steels with improved corrosion and creep properties. Ferritic 11% Cr alloys are used in the cold end components and 17 to 20% Cr ferritic alloys and austenitic Cr-Ni alloys in the hot end of the system.

Why these materials are suitable for particular applications as mentioned bellow

Rubber as Washer

Steel as structure support

Polythene as bag

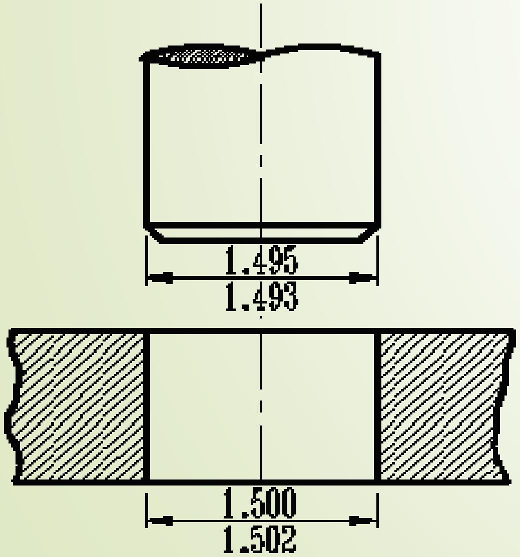
Thermocol for packing

Leather as Belt

Titanium alloy for Medical Implants

Tolerance

- A tolerance is the permissible variation from the specified dimension
- The designer must decide how much variation is allowable from the basic dimension of the component to accomplish the desired function.
- The tolerance on a part is the difference between the upper and lower allowable limits of a basic size dimension



Each manufacturing process has an inherent ability to maintain a certain range of tolerances, and to produce a certain surface roughness (finish).To achieve tolerances outside of the normal range requires special processing that typically results in an **exponential increase in the manufacturing cost**.

Types of Tolerance

Bilateral tolerance

The variation occurs in both directions from the basic dimension. That is, the upper limit exceeds the basic value and the lower limit falls below it.

2.500 ± 0.005 (This is the most common way of specifying tolerances)

Unilateral tolerance:

The basic dimension is taken as one of the limits, and variation is in only one direction

$$2.500^{+0.000}_{-0.010}$$

Standards & Codes in Design

Code is a collection of laws and rules that assists a government agency in meeting its obligation to protect the general welfare by preventing damage to property or injury or loss of life to persons.

S**tandard** is a generally agreed-upon set of procedures, criteria, dimensions, materials, or parts. Engineering standards may describe the dimensions and sizes of small parts like screws and bearings, the minimum properties of materials, or an agreed-upon procedure to measure a property like fracture toughness.

Some Background:

- The U.S. federal government is the largest single creator and user of standards: more than 45,000 (by current estimates)!
- About 210 organization are designated Standard Development Organizations (SDO's)
- Most Standards (about 90%) come from about 20 of these SDO's
- ASTM, ASME, IEEE, AISI (ASM), ASCE, MilStd (Mil Specs), are some of the most important SDO's

Taking them Global!

- ANSI and (U.S. National Committee (USNC)) are the U.S. clearing house for Standards and a founding member of ISO!
- Internationally we see Standard Organization in each of the major Industrial Nations and several Umbrella Groups:
  - International Organization for Standardization (ISO)
  - International Electro-technical Commission (IEC)
  - International Telecommunication Union (ITU)

Why Standards & Codes ?

- it makes the best practice available to everyone, thereby ensuring efficiency and safety.
- it promotes interchangeability and compatibility. With respect to the second point, anyone who has traveled widely in other countries will understand the compatibility problems with connecting plugs and electrical voltage and frequency when trying to use small appliances

How they're used:

- Standards are a "COMMUNICATION" tool that allows all users to speak the same language when reacting to products or processes
- They provide a "Legal," or at least enforceable, means to evaluate acceptability and sale-ability of products and/or services
- They can be taught and applied globally!
- They, ultimately, are designed to protect the public from questionable designs, products and practices
- They teach us, as engineers, how we can best meet environmental, health, safety and societal responsibilities

Organization	Initials	Country
Bureau of Indian Standards	BIS	India
Badan Standardisasi Nasional	BSN	Indonesia
Brazilian National Standards Organization	ABNT	Brazil
Spanish Association for Standarization and Certification	AENOR	Spain
French association for Standardization	AFNOR	France
American National Standards Institute	ANSI	U.S.
British Standards Institution	BSI	U.K.
Dirección General de Normas	DGN	Mexico
Deutsches Institut für Normung	DIN	Germany
Instituto Argentino de Normalización y Certificación	IRAM	Argentina
Bureau of Standards of Jamaica	BSJ	Jamaica
Euro-Asian Council for Standardization, Metrology and Certification	GOST	Russia (Soviet Union)
Colombian Institute of Technical Standards and Certification	ICONTEC	Colombia
Luxembourg Institute for Standardization, Accreditation, Security, and Quality of Products and Services	ILNAS	Luxembourg
Japanese Industrial Standards Committee	JISC	Japan
Korean Agency for Technology and Standards	KATS	Korea (Republic)
Nederlandse Norm	NEN	Netherlands
South African Bureau of Standards	SABS	South Africa
Standardization Administration of China	SAC	China
Standards Council of Canada	SCC	Canada
Swedish Standards Institute	SIS	Sweden
Finnish Standards Association	SFS	Finland

OBJECTIVE TREE

- Helps to organize customer requirements.

- It shows how different objectives are related to each other.

- The procedure for the objective tree method is as follows:
  1. Prepare a list of design objectives
  2. Order the list into sets of higher-level and lower-level objectives
  3. Draw a diagrammatic tree of objectives

2. The ladder should be safe

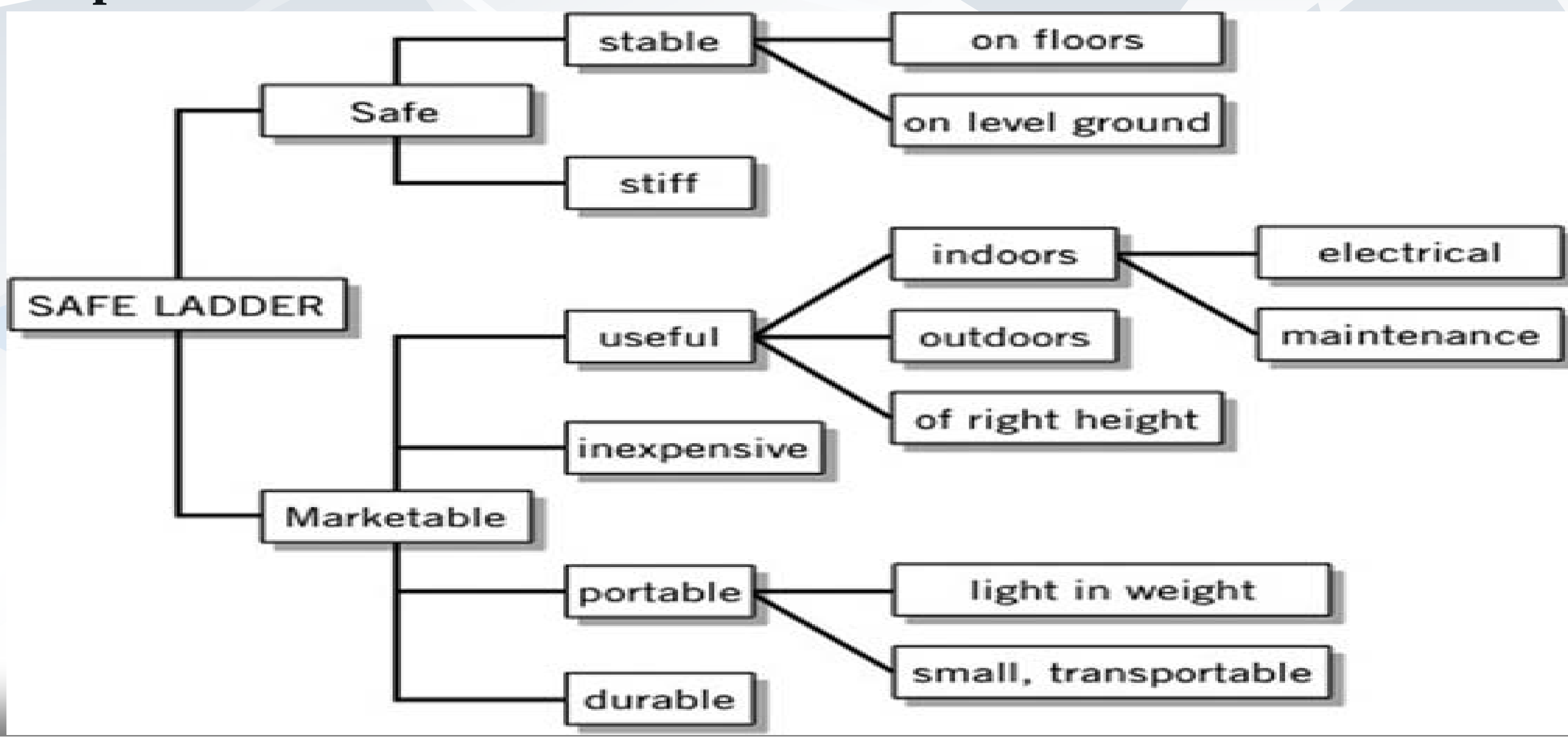
2.1 The ladder should be stable

2.1.1 Stable on floors and smooth surfaces

2.1.2 Stable on relatively level ground

2.2 The ladder should be reasonably stiff

Step 3:



- Following gives a list of objectives for a coffee maker

Safety	Convenience
Efficiency	Easy to use
Cheap to consumer	Fast
Quality	Makes good coffee
Volume of coffee	Doesn’t burn user
Temperature control	Good mixture
Automatic	Right temperature
Easy to clean	Splash proof
Timer	Energy saver

FUNCTIONAL STRUCTURE

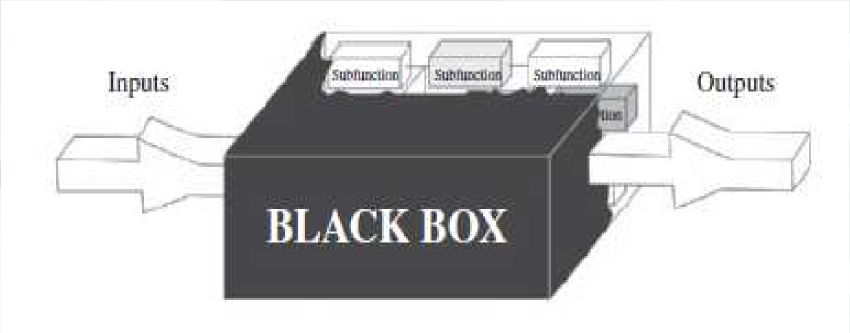
- **The primary purpose of function structures is to facilitate the discovery of solutions.**

- **A functional structure consists of the following:**

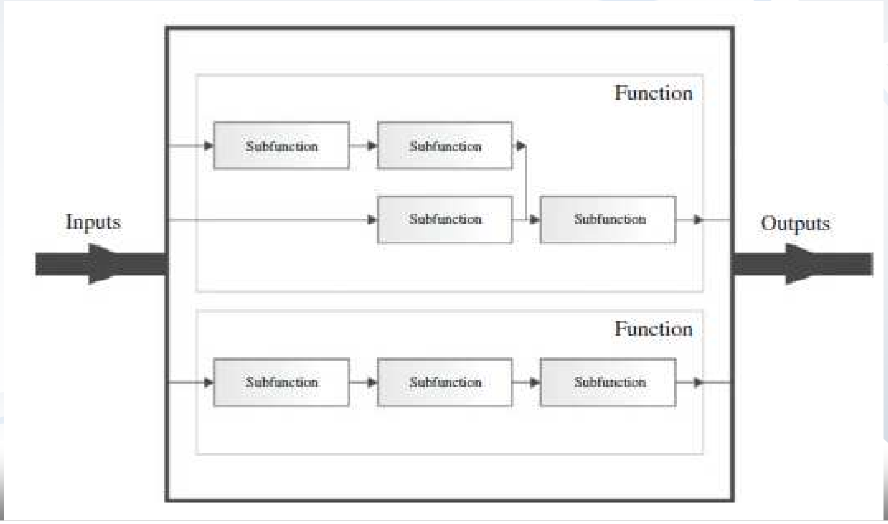
- ***A boundary box** (with inputs and outputs)*
- ***An overall function***
- ***Function tree***
- ***Known flow of materials, energy, and information***

BOUNDARY BOX & OVERALL FUNCTION

- *Black Box Model*



- *Transparent Box Model*



FOLLOW OF MATERIAL, ENERGY & INFORMATION

Conversion of energy

a. Changing energy (e.g., electrical to mechanical)

b. Varying energy components (e.g., increasing speed or torque)

c. Storing energy (e.g., storing potential or kinetic energy)

d. Connecting energy with information (e.g., switch to start a motor)

Functions concerned with the flow of energy in electromagnetic systems are mechanical, electrical, fluid, and thermal. Energy of this type can be supplied, stored, transformed, or dissipated.

Conversion of materials

a. Changing matter (e.g., melting [solid to liquid])

b. Connecting matter with energy (e.g., moving parts)

c. Rearranging materials (e.g., mixing or separation)

d. Storing materials (e.g., storing material in a silo)

Material can be designed to alter its position or shape. Usual action verbs are lift, position, hold, support, move, translate, rotate, and guide.

Material can be divided into two or more bodies. The action verbs are disassemble and separate.

Material assembly. Usual terms are mix, attach, and position relative to.

Conversion of information

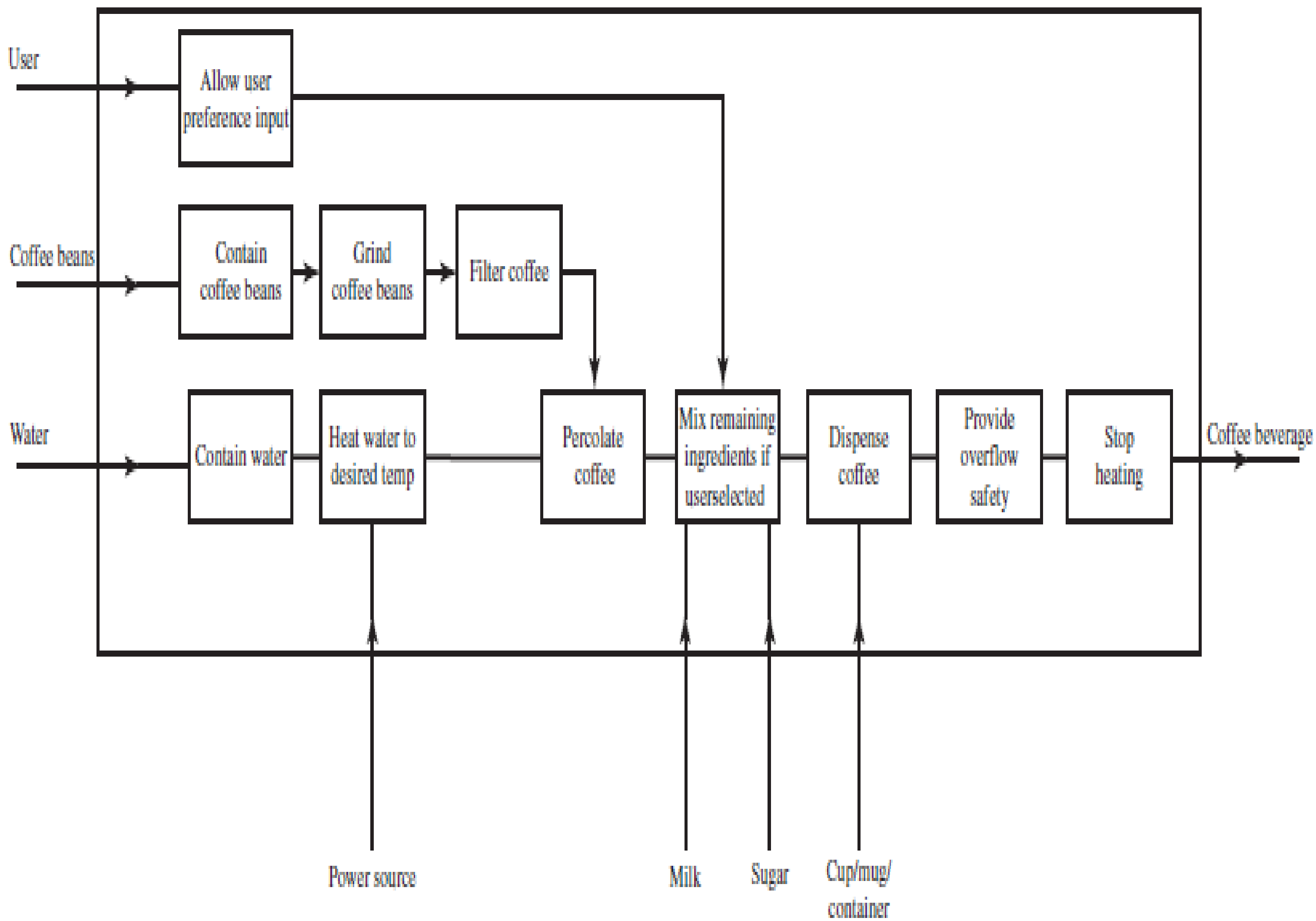
Functions associated with the flow of information are usually in the form of mechanical or electrical signals or software.

a. Changing signals (e.g., mechanical to electrical)

b. Connecting information with energy (e.g., amplifying signals)

c. Connecting information with matter (e.g., marking metals)

d. Storing signals (e.g., data banks)


User
Coffee beans
Water
Allow user preference input
Contain coffee beans
Grind coffee beans
Filter coffee
Contain water
Heat water to desired temp
Percolate coffee
Mix remaining ingredients if userselected
Dispense coffee
Provide overflow safety
Stop heating
Coffee beverage
Power source
Milk
Sugar
Cup/mug/ container